Claims

[c1]   1.A facial pose estimation system for determining a orientation of a user's face, comprising:

a head tracker that determines a position of a head of the user;

a face detection system that determines a position of the face; and

a position comparator that compares the head position and the face position to each other to obtain the orientation.

[c2]   2.The facial pose estimation system as set forth in claim 1, wherein the position comparator further comprises:

a head position bar line indicating the head position; and

a face position bar line indicating the face position.

[c3]   3.The facial pose estimation system as set forth in claim 2, wherein the orientation is obtained by determining an angle between the head position bar line and the face position bar line.

[c4]   4.A facial pose estimation system for tracking a head and estimating a facial pose of a face on a head, comprising:

a head tracker for tracking the head and computing a head position by fusing results of multiple sensing modalities;

a face detection system for detecting the face and computing a face position using a relational template over a geometric distribution of a non-intensity image property; and

a position comparator that uses an angle between the head position and the face position to determine the facial pose.

[c5]   5.The facial pose estimation system as set forth in claim 4, wherein the head tracker further comprises a sensor fusion analysis processor to fuse the results of multiple sensing modalities.

[c6]   6.The facial pose estimation system as set forth in claim 4, wherein the head tracker further comprises a Bayesian model capable of inferring probabilistic dependencies among variables and conditional probabilities characterizing dependencies.

[c7] 7.The facial pose estimation system as set forth in claim 4, wherein the face detection system further comprises a feature extraction module that extracts features using a non-intensity image property.

[c8] 8.The facial pose estimation system as set forth in claim 7, wherein the non-intensity image property is edge density.

[c9] 9.The facial pose estimation system as set forth in claim 7, wherein the feature extraction module further comprises a feature template that extracts features by determining an amount of high-frequency variation.

[c10] 10.The facial pose estimation system as set forth in claim 4, wherein the face detection system further comprises a hypothesis module that generates a hypothesis about a location of the face.

[c11] 11.A method for determining a facial pose of a user, comprising:
obtaining an image that contains a head of the user using a camera;
processing the image to determine a position of the head;
detecting a face on the head;
determining a position of the face; and
comparing the head position and the face position to obtain the facial pose.

[c12] 12.The method as set forth in claim 11, wherein comparing the head position and face position further comprises finding a deviation angle between the head position and the face position.

[c13] 13.The method as set forth in claim 12, further comprising comparing the deviation angle to a threshold angle to determine whether the user is facing the camera.

[c14] 14.The method as set forth in claim 13, further comprising determining that the user is facing the camera if the deviation angle is less than the threshold angle.

[c15] 15.The method as set forth in claim 13, further comprising determining that the user is not facing the camera is the deviation angle is greater than the threshold angle.

[c16]   16. The method as set forth in claim 11, further comprising computing a center of the head using the head position and a center of the face using the face position.

[c17]   17. The method as set forth in claim 16, further comprising determining a deviation angle, the deviation angle defined as an angle between a head line and a face line, wherein the head line is a line from a center of a camera to the head center and the face line a line from the camera center to the face center.

[c18]   18. A method for determining whether a user is facing a monitor, comprising:
obtaining an image using a camera, the image containing a head of the user;
defining a center line of the image as a line that bisects the user's head into two approximately equal parts;
finding a face on the head and determining a centroid of the face;
computing a deviation distance between the center line and centroid of the face; and
using the deviation distance to determine whether the user is facing the monitor.

[c19]   19. The method as set forth in claim 18, wherein determining whether the user is facing the monitor includes comparing the deviation distance to a threshold value.

[c20]   20. The method as set forth in claim 19, wherein a determination is made that the user is facing the monitor if the deviation distance is less than the threshold value.

[c21]   21. The method as set forth in claim 19, wherein a determination is made that the user is not facing the monitor if the deviation distance is greater than the threshold value.

[c22]   22. The method as set forth in claim 18, further comprising providing the determination as to whether the user is facing the monitor to an application program.

[c23]
             23. The method as set forth in claim 22, further comprising having the

application program notify the user of an event if a determination is made that the user is facing the monitor.

[c24]   24. A computer-readable medium having computer-executable instructions for estimating the orientation of a face, comprising:

using a camera to obtain an image containing a head;

finding a center of the head in the image;

detecting a face on the head and finding a center of the face in the image; and

finding any divergence between the head center and the face center to estimate the facial pose.

[c25]   25. The computer-readable medium as set forth in claim 24, further comprising tracking the head to ensure that the image contains the head.

[c26]   26. The computer-readable medium as set forth in claim 24, further comprising tracking the head by fusing results of multiple sensing modalities.

[c27]   27. The computer-readable medium as set forth in claim 24, further comprising detecting the face by extracting features from the image using a non-intensity image property and grouping the extracted features into facial regions.

[c28]   28. The computer-readable medium as set forth in claim 24, further comprising detecting the face by using a relational template and a relationship between facial regions that is based on a non-intensity image property.

[c29]   29. The computer-readable medium as set forth in claim 24, further comprising finding the face center by generating a hypothesis about a location of the face within the image and defining a sub-region within the image to search for the face.

[c30]

30. A computer-implemented attention detection system for determining where a user's attention is focused, comprising:

at least one monitor that provides the user with visual information;

a camera disposed on the monitor that captures images of the user; and

a facial pose estimation system that receives the captured images and outputs facial pose information containing an estimate of a facial pose of the user to

determine where the user's attention is focused.

[c31]   31.The computer-implemented attention detection system as set forth in claim
         30, further comprising a screen saver application in communication with the
         monitor that receives the facial pose information and uses the information to
         decide whether to start and terminate the screen saver application on the
         monitor.

[c32]   32.The computer-implemented attention detection system as set forth in claim
         30, further comprising a plurality monitors and a monitor application that uses
         the facial pose information to determine which of the plurality of monitors the
         user is observing.

[c33]   33.The computer-implemented attention detection system as set forth in claim
         30, further comprising an instant messaging application that receives the facial
         pose information and uses the information to decide whether to display a
         message to the user on the monitor.